



(12) **EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:  
**10.04.2024 Bulletin 2024/15**

(51) International Patent Classification (IPC):  
**F01D 5/14** <sup>(2006.01)</sup> **F01D 5/18** <sup>(2006.01)</sup>  
**F01D 9/06** <sup>(2006.01)</sup>

(43) Date of publication A2:  
**01.11.2023 Bulletin 2023/44**

(52) Cooperative Patent Classification (CPC):  
**F01D 5/147; F01D 5/189; F01D 9/065;**  
F05D 2230/211; F05D 2240/126; F05D 2250/75;  
F05D 2260/221; Y02T 50/60

(21) Application number: **23196960.1**

(22) Date of filing: **12.11.2020**

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

(72) Inventors:  
• **SPANGLER, Brandon W.**  
Vernon (US)  
• **PACK, David R.**  
Gold Canyon (US)

(30) Priority: **13.11.2019 US 201916682453**

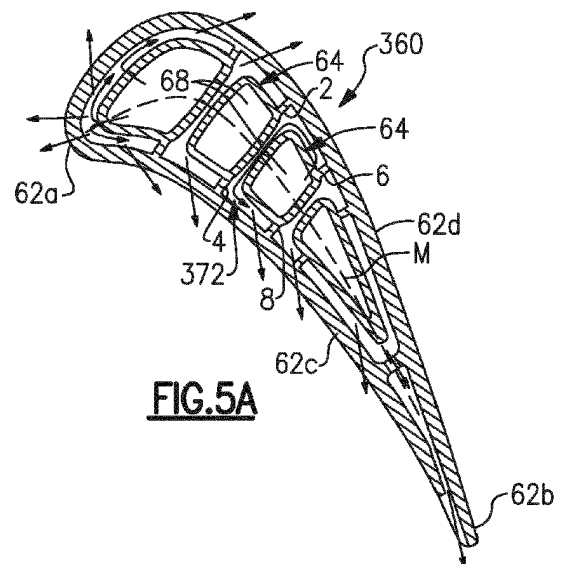
(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:  
**20207281.5 / 3 822 455**

(74) Representative: **Dehns**  
**St. Bride's House**  
**10 Salisbury Square**  
**London EC4Y 8JD (GB)**

(71) Applicant: **RTX Corporation**  
**Farmington, CT 06032 (US)**

(54) **AIRFOIL WITH RIBS DEFINING SHAPED COOLING CHANNEL**

(57) An airfoil (60) includes an airfoil wall (62) that defines a leading end (62a), a trailing end (62b), a pressure side (62c), a suction side (62d), and a mean line (M). First and second ribs (64) each connect the pressure side (62c) and the suction side (62d). Each of the first and second ribs (64) define a tube portion (66) that circumscribes a rib passage (68), and first and second connector arms (1, 2, 5, 6, 3, 4, 7, 8) that solely join the tube portion (66) to, respectively, the pressure side (62c) and the suction side (62d). The first rib (64), the second rib (64), and the airfoil wall (62) bound a continuous cooling channel (72) there between. The continuous cooling channel (72) has a pressure side portion (72a) to the pressure side of the mean line (M) and a suction side portion (72b) to the suction side of the mean line (M). The pressure side portion (72a) and the suction side portion (72b) each have a cross-sectioned shape that is an L-shape.





## EUROPEAN SEARCH REPORT

Application Number

EP 23 19 6960

5

10

15

20

25

30

35

40

45

50

55

1

EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 624 231 A (OHTOMO FUMIO [JP] ET AL) 29 April 1997 (1997-04-29) * column 10, lines 23-48; figure 7 * -----	1,5-10	INV. F01D5/14 F01D5/18 F01D9/06
E	EP 3 783 198 A1 (RAYTHEON TECH CORP [US]) 24 February 2021 (2021-02-24) * paragraph [0042]; figure 6 * -----	1-3,8-10	
A	WO 2015/171145 A1 (SIEMENS ENERGY INC [US]) 12 November 2015 (2015-11-12) * page 11, line 16 - page 12, line 4; figures 1,4 * * page 7, lines 10-20; claim 8 * -----	1-10	
A	WO 2017/039572 A1 (SIEMENS AG [DE]; SIEMENS ENERGY INC [US]) 9 March 2017 (2017-03-09) * paragraphs [0017], [0026]; figure 6 * -----	1-10	
A	US 2012/269647 A1 (VITT PAUL H [US] ET AL) 25 October 2012 (2012-10-25) * paragraph [0024]; figure 2 * -----	1-10	TECHNICAL FIELDS SEARCHED (IPC)
A	WO 2015/195086 A1 (SIEMENS ENERGY INC [US]) 23 December 2015 (2015-12-23) * page 6, line 30 - page 7, line 11; figures 2,4 * -----	1-10	F01D
<p><del>The present search report has been drawn up for all claims</del></p>			
Place of search		Date of completion of the search	Examiner
Munich		20 November 2023	Teusch, Reinhold
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			



Application Number

EP 23 19 6960

5

10

15

20

25

30

35

40

45

50

55

**CLAIMS INCURRING FEES**

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

**LACK OF UNITY OF INVENTION**

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

**see sheet B**

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

**1-10**

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

**LACK OF UNITY OF INVENTION  
SHEET B**

Application Number

EP 23 19 6960

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

**1. claims: 1-10**

Airfoil with two ribs, each comprising a tube portion joined solely by a first and a second connector arm to the pressure side and the suction side, the ribs and the airfoil wall bounding a continuous cooling channel there between, the pressure side portion and the suction side portion of this cooling channel each having a cross-sectioned shape that is an L-shape.

---

**2. claim: 11**

Airfoil with two ribs, each comprising a tube portion joined solely by a first and a second connector arm to the pressure side and the suction side, the ribs and the airfoil wall bounding a continuous cooling channel there between, the first connector arm and/or the second connector arm being an extension of a side wall of the tube portion.

---

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 23 19 6960

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

20-11-2023

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
<b>US 5624231 A</b>	<b>29-04-1997</b>	<b>JP 3651490 B2</b>	<b>25-05-2005</b>
		<b>JP H07189602 A</b>	<b>28-07-1995</b>
		<b>US 5624231 A</b>	<b>29-04-1997</b>
<b>EP 3783198 A1</b>	<b>24-02-2021</b>	<b>EP 3783198 A1</b>	<b>24-02-2021</b>
		<b>US 2021054746 A1</b>	<b>25-02-2021</b>
<b>WO 2015171145 A1</b>	<b>12-11-2015</b>	<b>EP 3140515 A1</b>	<b>15-03-2017</b>
		<b>US 2017101893 A1</b>	<b>13-04-2017</b>
		<b>WO 2015171145 A1</b>	<b>12-11-2015</b>
<b>WO 2017039572 A1</b>	<b>09-03-2017</b>	<b>CN 108026773 A</b>	<b>11-05-2018</b>
		<b>EP 3322880 A1</b>	<b>23-05-2018</b>
		<b>JP 6594525 B2</b>	<b>23-10-2019</b>
		<b>JP 2018529043 A</b>	<b>04-10-2018</b>
		<b>US 2019024515 A1</b>	<b>24-01-2019</b>
		<b>WO 2017039572 A1</b>	<b>09-03-2017</b>
<b>US 2012269647 A1</b>	<b>25-10-2012</b>	<b>CN 103492677 A</b>	<b>01-01-2014</b>
		<b>EP 2699763 A1</b>	<b>26-02-2014</b>
		<b>US 2012269647 A1</b>	<b>25-10-2012</b>
		<b>WO 2012145121 A1</b>	<b>26-10-2012</b>
<b>WO 2015195086 A1</b>	<b>23-12-2015</b>	<b>CN 106471212 A</b>	<b>01-03-2017</b>
		<b>EP 3158169 A1</b>	<b>26-04-2017</b>
		<b>JP 6239163 B2</b>	<b>29-11-2017</b>
		<b>JP 2017527727 A</b>	<b>21-09-2017</b>
		<b>US 2017089207 A1</b>	<b>30-03-2017</b>
		<b>WO 2015195086 A1</b>	<b>23-12-2015</b>